Research Note

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ACCURACY OF GROUND POINT LOCATION FROM AERIAL PHOTOGRAPHS

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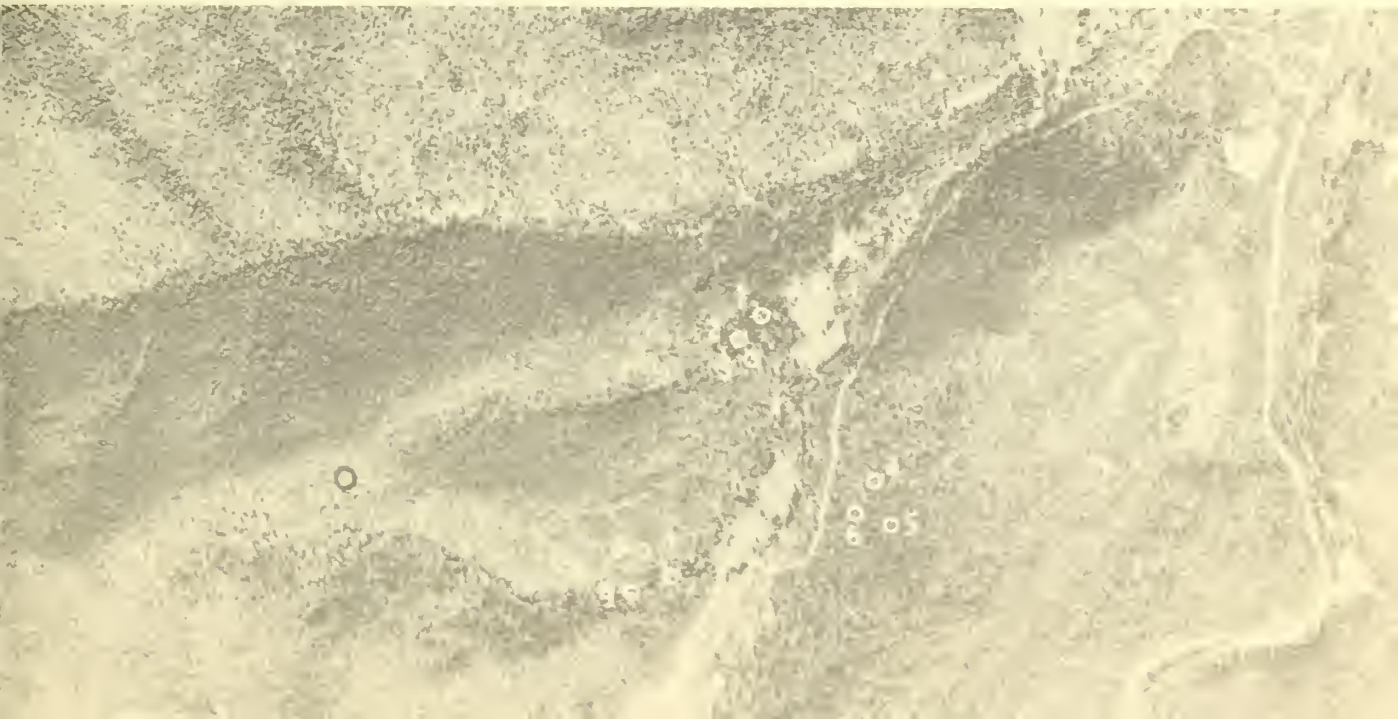
ABSTRACT

The error of ground point location using aerial photos is commonly believed to be quite small. A recent study considering 84 points located with 1:16,000-scale aerial photos indicated the average error in ground location to be about 30 feet on lines averaging 500 feet in length. Errors averaged 17 feet in distance and 19 feet in direction, or slightly more than the width of a dull pencil line on the scale photos used.

Selected points were carefully located on the ground and marked on the aerial photos.



Aerial photos are commonly used in the ground location of previously selected points. The 2-power pocket stereoscope, photo-scale protractor, and the procedures described in "Aerial Photo Scale Protractors for Mountainous Areas" (Research Note 40) are used for this point location. Fieldwork also requires the use of staff compass and 100-foot steel tape.

Since base lines are selected near to and in the same datum as the point to be located, and since the lines run from these base lines to the selected points rarely exceed 1,000 feet in length, the error of location on the ground is commonly supposed to be quite small. However, this rather optimistic assumption is rarely checked; therefore, the question arises: How accurately can one actually locate points on the ground by using aerial photos?

THE STUDY

This paper reports results from study of the 84 point locations made by 15 two-man field parties during a recent Forest Survey training school at Fraser Experimental Forest, Colorado.

Eighteen points in groups of three were pinpointed and circled on two 1:16,000-scale aerial photos. Although these points were located in an area generally considered to be rugged mountainous terrain, the test areas were near the valley floor and in no case did the slope of the lines to be run exceed 25 percent. These points were located on the ground by the most precise method available and a small, easily disguised stake was driven at each. The supervisors who located these points ran a line to a central point in each cluster and then short lines to the individual plot centers. These locations were then checked.

All men were given 16 hours of photo training, including three office problems. During this time they determined scale of photos, bearing, and distance from base lines to previously selected points in the manner to be used during the test. Each two-man crew was equipped with stereo pairs of photos with plot locations marked, pocket stereoscope, photo-scale protractor, needle point, pencil, tatum, staff compass, and 100-foot tape. Crews were briefed on which points to locate and told to lay out one base line on each pair of photos and to complete as many plots as possible in 8 hours.

One member of the permanent Forest Survey staff was assigned to each three-point group as referee. As each crew completed a line, the referee recorded length of line run and its direction, and the distance and bearing from the accepted location to the location made by the crew.

These records were plotted, checked for bias, and analyzed.

RESULTS AND DISCUSSION

Averages obtained from these records are tabulated below:

Length of lines run from base lines	500±59 feet
Number of points located	5 per crew
Error in location	29.4±3.9 feet
Directional error	19.4±2.6 feet or 2°13'
Distance error	16.8±2.8 feet
Proportion of lines to the right	54 percent
Proportion of lines too long	64 percent

These errors seem rather large for such short lines, yet the study indicates that such errors are probably normal for this technique.

Let us examine the procedure and tools used. To recover a ground location pinpointed on the aerial photo, the forester selects and pinpoints trees or other landmarks defining a base line that can be located both on the photos and on the ground. From this line he determines local photo scale and bearing. He also pinpoints a landmark on or near the line to be used as a reference or starting point. On his photos he measures the length of the base line, the distance from reference point to the point he is locating, and the bearing angle between this line and the base line, using a scale graduated to 25 feet and a protractor graduated in degrees. On the ground he measures the bearing and length of the base line, and then runs a compass line with the indicated bearing and distance from the reference point to the point to be located. To do this he used a standard steel tape and Forest Service staff compass graduated in one-half degrees.

This procedure, when used with 1:16,000-scale aerial photos, could hardly be expected to result in average errors much less than those obtained in this study.

What does a 17-foot average error in distance or a 19-foot average error in direction really mean on a 1:16,000-scale aerial photo? These distances measure about 0.012 to 0.015 inch or slightly more than the width of a line or dot made with a dull pencil on the photo.

Since these are total errors they include errors of measurement on photos as well as errors in fieldwork. Analysis of more than 200 photo measurements made under office conditions by foresters attending aerial photo training schools showed average errors of:

±41 minutes (about 6 feet in 500 feet) in direction
±13.2 feet in 500 feet in distance.

This means that as much as one-third of the average error in direction and two-thirds of the average error in distance experienced in locating points on the ground can be due to the limitations of photo scales and techniques now in use.

These data strongly indicate that any significant improvement in the accuracy of point location must come through using larger scale photos rather than longer time in intensive field training.

To recover point 7 on the ground, the fieldman selects and pinpoints on his photo landmarks A and B defining the base line, and landmark RP as a starting point. He orients his photo-scale protractor over the intersection of the base line and compass line extended, by means of the bearing of base line AB (S. 32° W.) and reads bearing of compass line RP to 7 (N. 80° W.). Using the relationship of ground distance to photo distance determined by measurements of A-B he selects the correct scale and measures the distance RP to 7. His average error in recovering points on the ground can be expected to be about 30 feet.